Westinghouse Electric Company

Technical Bulletin

An advisory of a recent technical development pertaining to the installation or operation of Westinghouse-supplied nuclear plant equipment. Recipients should evaluate the information and recommendation, and initiate action where appropriate.
P.O. Box 355, Pittsburgh, PA 15230

Subject:		Number:
Information Regarding Recent CROSSFLOW Ultrasonic Flow Measurement System Performance Observations		**TB-04-4**
System(s): CROSSFLOW Ultrasonic Flow Measurement System		Date: 02/12/2004
Affected Plants: See page 5		S.O.:
References: See page 4	Affects Safety Related Equipment: Yes ☐ No ☒	Page: 1 of 5

BACKGROUND

Two recently identified CROSSFLOW performance observations are discussed in this Technical Bulletin. The first observation is based on some recent data collected at two plants (from two different utilities) during the commissioning period (i.e., prior to adjusting plant power), it was found that plant configuration (realignment) changes in the feedwater system resulted in readily identifiable changes in the Venturi Flow Correction Factor, C_f, that were outside of established limits. While sensitivity to configuration changes/realignment is not an unexpected occurrence, based on operating experience, at this time Westinghouse and its CROSSFLOW partner, the Advanced Measurement Analysis Group (AMAG) have not determined the cause of the sensitivity for these specific CROSSFLOW installations. These occurrences continue to be investigated. Once the cause is known, additional information will be provided and, if required, appropriate action initiated.

Additional information, if required, may be obtained from Bill Turkowski Telephone (412) 374-4024 or John McInerney Telephone (412) 374-5724

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Since this response of the CROSSFLOW system relates to specific feedwater system configurations, this performance variability at a given plant is unique to that plant and may not be directly applicable to other CROSSFLOW installations. Further, the ability of the CROSSFLOW system to respond to feedwater system configuration changes in a detectable manner minimizes the potential for use of an inappropriate C_f. It should be noted that although the cause of the performance observations is not known at this time, these observations are believed to be unrelated to the recently discussed signal interference issue (see Westinghouse TB-03-6 and NSAL-03-12).

The second observation relates to preliminary results from tracer tests at one of the utilities and exhibits a larger than expected deviation between the flow results obtained for the tracer versus CROSSFLOW readings. Evaluation of this information is in progress and no conclusions have been drawn at this time.

RECOMMENDED ACTIONS

PLANT CONFIGURATION CHANGES

Changes in CROSSFLOW performance when feedwater system configuration or alignments are changed is not unexpected based on operating history. However, for the two recent observations, Westinghouse/AMAG have not yet determined the cause of the configuration change sensitivity and are, therefore, providing this notification to all CROSSFLOW users for information.

As noted above, the change in CROSSFLOW performance due to changes in feedwater system equipment is readily identifiable through an observable change in the C_f. The guidance previously issued in Westinghouse NSAL-03-12, relating to the signal interference issue, is also applicable to and can be used to identify if CROSSFLOW performance is being affected due to changes in feedwater system equipment configuration. A summary of the pertinent, applicable recommendations from NSAL-03-12 are repeated here for information:

1. Assurance of a feedwater system free of signal interference should be confirmed. Westinghouse/AMAG has completed a review of frequency spectrum records, or has obtained new records, for all Utilities currently using CROSSFLOW to adjust plant power. The signal interference issue affected no other plants.
2. Westinghouse/AMAG recommends that the performance of the CROSSFLOW system be re-evaluated whenever a modification is made to the feedwater system that has the potential to affect the flow characteristics and/or a power uprate is implemented. This action ensures that interference or in this case other factors are not unknowingly introduced which could adversely affect subsequent CROSSFLOW performance.
3. CROSSFLOW system users should continue to ensure their application stays within its plant specific acceptance limits using the guidance provided in NSAL-03-12 and the information (e.g. Users manual, uncertainty calculations, etc) provided with the CROSSFLOW system. Utilities should also verify that operation procedures have been updated to reflect these recommendations.

In light of the recent unexplained configuration change sensitivity observations, CROSSFLOW users should be vigilant with regard to changes in CROSSFLOW system performance whenever changes to equipment configurations or realignments within the feedwater system are being made. Changes to C_f, if any, should be documented and adjustments should be made accordingly. As long as the value of C_f remains steady and within the plant specific upper or lower maximum operational limits reasonable assurance exists that the CROSSFLOW system is performing properly. If on the other hand, a variation in

C_f occurs that is outside of established limits that cannot be attributed to a known change in plant conditions (such as fouling, defouling or an actual change in feedwater flow), it is recommended that C_f be reset to remove CROSSFLOW from service and the utility evaluate the CROSSFLOW system performance with support from Westinghouse/AMAG, as appropriate.

FLOW MEASUREMENT DEVIATIONS

The CROSSFLOW system is designed to achieve flow measurement uncertainty of 0.5% or better, with a 95% confidence interval when installed in accordance with the CROSSFLOW topical report (CENPD-397-P-A, Rev. 1) and there is confirmation of the absence of signal interference. The actual plant specific uncertainty is determined via a QA'd uncertainty analysis. It is important to note that Westinghouse/AMAG have no information that would lead us to believe that these conditions were not met for all current CROSSFLOW installations (i.e., installed in accordance with the topical report and free of signal interference).

Westinghouse/AMAG considers that reasonable assurance that the CROSSFLOW system is operating as designed can be obtained by making use of other corroborating plant performance parameters or plant specific operating history. It should be noted that each plant is unique and, therefore, corroborating information will in general be plant specific. For example, but not limited to:

1. Confirmation of CROSSFLOW system performance based on analytical techniques, analytical models and/or supporting test data.
2. Turbine cycle heat rate consistent with the thermal kit.
3. Availability of independent feedwater flow measurement such as a calibrated ASME flow element or a chemical tracer test.
4. Plant power changes do not result in C_f changes that exceed the normal repeatability of the meter.
5. Confirmation that C_f is not sensitive to the realignment of equipment in the feedwater system (e.g., bypassing the last stage of high pressure feedwater heater or changing feedwater pump alignment). Such confirmation may be available through historical plant operation records that demonstrate that the change in C_f, following the realignment, does not exceed the normal repeatability of the meter.
6. Operation procedures that restrict CROSSFLOW use to upstream alignments, where meter accuracy has been previously confirmed.
7. Operating history demonstrating stability of CROSSFLOW system performance consistent with plant and system response.

In summary, if a utility has confirmed that an appropriate baseline has been established (e.g., Item 1, 2 or 3) and that day-to-day operation is stable (e.g., Item 4, 5, 6 or 7), there is reasonable assurance that CROSSFLOW can continue to be operated as intended while the investigation of the issues discussed in this Technical Bulletin are pursued.

If the CROSSFLOW system performance is outside the expected plant specific acceptance limits, it is recommended that that C_f be reset to remove CROSSFLOW from service and the utility evaluate the CROSSFLOW system performance with support from Westinghouse/AMAG, as appropriate.

Although, the results of the Westinghouse and AMAG investigations are still preliminary, utility users are being informed of these issues to keep them aware of information currently available. Westinghouse intends to schedule a meeting with CROSSFLOW users within the next few weeks to share developing

information and plant specific operation experiences and practices that relate to the observations discussed in this Technical Bulletin. This information is also being shared with the Nuclear Regulatory Commission. All parties will be kept apprised of the status as these observations are investigated.

Additionally, although based on a prior evaluation we believe that this issue does not represent a substantial safety hazard, Westinghouse is evaluating these observations under our Part 21 process. Evaluations of safety analyses for which Westinghouse holds the analysis of record (AOR) were performed for an overpower condition (see Westinghouse NSAL-03-12). The overall conclusion was that the applicable regulatory acceptance criteria were met for all of the UFSAR Chapters 6 and 15 events evaluated. Considering the margins available in the system designs and safety analyses, if the CROSSFLOW signal were in error, the error went undetected and the plant operated at an overpower condition, it is expected that the regulatory acceptance criteria would continue to be met.

REFERENCES

1. TB-03-6, "CROSSFLOW Ultrasonic Flow Measurement System Signal Issues", 09/05/2003
2. NSAL-03-12, "CROSSFLOW Ultrasonic Flow Measurement System Flow Signal Interference Issues", 12/05/2003
3. CENPD-397-P-A, Rev. 1, "Improved Flow Measurement Accuracy Using CROSSFLOW Ultrasonic Flow Measurement Technology", 5/26/2000

List of CROSSFLOW Users

CROSSFLOW Installation Summary - U.S.	
Braidwood Units 1 & 2	Hope Creek Unit 1
Byron Units 1 & 2	Kewaunee
Calvert Cliffs Units 1 & 2	La Salle Units 1 & 2
Clinton	Monticello
Diablo Canyon Units 1 & 2	Palisades
Dresden Units 2 & 3	Pilgrim
Duane Arnold	Salem Units 1 & 2
Fermi	San Onofre Units 2 & 3
Ft. Calhoun	South Texas Units 1 & 2
Hatch Units 1 & 2	Vermont Yankee

CROSSFLOW Installation Summary - International Units	
Brazil	**Spain**
Angra Unit 1	Almaraz Units 1 & 2
Japan	**Sweden**
Genkai Units 1 - 4	Ringhals Unit 3
Sendai Units 1 & 2	